CHAPTER XVIII

A New Mission: Petroleum Distribution

Of the many supplies which passed through reconstructed ports, petroleum products were among the most vital.[1] Gasoline and fuel oil accounted for more than one half of the tonnage shipped overseas during World War II. From 300,000 to 800,000 gallons a day were required by a field army or a tactical air force. To distribute such amounts by tank car or truck placed unwonted burdens on railways and roads, and, in case trucks were used, added considerably to the consumption of gasoline. Trucks delivering gasoline over the Burma Road consumed half of their load in making the trip.[2]

Beyond the port area, where tankers discharged their loads to bulk tank farms, the speed with which gasoline and fuel oil could be distributed to field armies and air bases in large part determined the tempo of offensive action. Rapid distribution was imperative. The Corps of Engineers developed for this mission a new type of unit, the petroleum distribution company. Such companies, equipped with lightweight, easily assembled pipes and storage tanks, and portable pumping stations, greatly reduced the logistic effort in time, tonnage, and manpower.

Pipelines did not replace completely the earlier methods of distribution. The Quartermaster Corps (QMC) distributed great quantities of petroleum products by tank, drum, and can. At any beachhead or landing point the initial supply was still lightered ashore in drums and cans and moved forward by the Quartermaster Corps. The Corps of Engineers meanwhile installed marine pipelines from floating tankers to bulk storage tanks ashore. From such tank farms the Engineers then ran pipelines to more forward QMC refilling points, extending the system of pipelines, pumping stations, and storage tanks inland as required by the advancing forces.[3]

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[1] Unless otherwise indicated, this chapter on petroleum distribution is based upon: (1) ERDL file, EB 143; (2) Col James E. McNary and Col Edson W. Berlin, Hist of Dev of Mil Pipelines, 28 Dec 45, typescript in EHD file, Hist of Dev of Mil Pipelines; (3) QMC 400.112, Pipeline, Portable; (4) 353, Engr Heavy Shop Units, Claiborne, Bulky; (5) 220.3, Engr Petroleum Distr Units; (6) Tel Conv, Lt Col Kenneth L. Treiber, 27 Aug 53; (7) 353, ASFTC Claiborne, Pt. 2; (8) 475, ASFTC Claiborne; (9) P&T Div file, Petroleum Distr Units (S); (10) Mech Equip Br file, Portable Pipelines, Shenandoah National Park; (11) S–3 Memos for File, EUTC Claiborne, 1943–44, EHD files; (12) Engr Bd Rpt 756, Final Rpt on Submarine Sea Loading Lines, 10 Jul 43; (13) Engr Sch Spec Text, ST–5–350–1, Military Pipe-Line Systems; (14) Hist Rpt 13, Liaison Sec Intel Div, Office of C Engr ETO, Petroleum-Oil-Lubricants. AG Special Collection, Opn Rpts; (15) Unit Tng, Annex I. (16) Ltr, Chauncey W. Karstens to C of Mil Hist, 29 Jan 54, with Incl.

[2] (1) Charles F. Romanus and Riley Sunderland, *Stilwell's Mission to China,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1953), Ch. I. (2) Joseph Bykofsky and Harold Larson, *The Transportation Corps: Operations Overseas,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1956), Ch. IX.

[3] See Risch, *QMC: Organization, Supply and Services, Vol. I,* pp. 34, 35, 144–46.

Restricted Use of Pipelines by the Quartermaster Corps

Realizing the potentialities of this combination, a handful of officers, representing various services, had begun during the thirties to advocate pipelines as a supplement to and a partial replacement of distribution of petroleum by truck or rail. Those who argued for the Army's adoption of pipelines could point to precedents. The Corps of Engineers had used pipelines while building the Panama Canal. During World War I the Engineers had connected several tank farms to dock areas. During the same war a thirty-six-mile pipeline laid across Scotland from just south of Glasgow on the Clyde to Grangemouth on the Firth of Forth supplied the oil which otherwise would have had to be shipped in tankers through the submarine-infested waters of the North Sea.[4] After 1930 several large military airfields installed pipeline distribution systems. The Navy had used pipelines extensively for refueling ever since 1915 when it had switched from coal to oil. The petroleum industry, expanding rapidly after World War I, developed a field system to handle drilling mud and water, and to gather crude oil. Pipelines soon brought crude oil from field to refinery and short lines carried products from refinery to shipping points. But compared to other means of petroleum distribution, pipelines had been used very little. Their advocates could only point out that the success of the few systems installed argued for their military feasibility.

Until the late twenties petroleum pipelines had been constructed of sections of heavy pipe, screwed or welded together. Because of the difficulties of transporting, handling, and assembling, such a design did not lend itself readily to the needs of the military. By the beginning of World War II the petroleum industry had designed a lightweight, easy-to-assemble, pipeline system. A standard 20-foot length of 4-inch pipe weighed 186 pounds. A lighter 4-inch pipe, later called "invasion tubing," weighed only 68 pounds. Each could be fitted at either end with a nipple grooved to match what was commonly called a victaulic coupling, after one of its fabricators, the Victaulic Company of America. The victaulic, or similarly designed coupling, consisted of a synthetic rubber gasket held in place by two semicircular metal castings. Hydraulic pressure from inside the pipe caused the gasket to expand and form a joint that would, except in unusually rugged terrain, hold as tight as if welded. Unlike a welded coupling, the joint was not rigid but allowed about six degrees of flexibility. Although this type of coupling had been developed in Britain during World War I, it had not been used for years thereafter except in water and sewerage systems because no gasket material had been found that would resist for long the action of crude oil and refined products. With the introduction of synthetic rubber gaskets in the mid-1930's pipelines coupled in this manner became feasible.

In December 1939, the manager of the Transportation Department of the Shell Oil Company, Incorporated, offered the QMC, as the service responsible for the purchase and distribution of petroleum products, a study entitled "Transportation of Gasoline in the Theatre of Operations." The study was both imaginative and practical, applying the accumulated knowledge of the petroleum industry to a military require-

[4] Suggested Corrections, 12 Dec 45, by McNary to Hist of Dev of Mil Pipelines. EHD file, Hist of Dev of Mil Pipelines.

ment, at that time only vaguely comprehended. The study contained all of the major elements of the military pipeline systems that were to be used during World War II, including lines from ship to shore, bulk storage tanks beyond the water line, and a pipeline with pumping units leading right up to the front lines. During January and February 1940, the manuscript passed from one desk to another in the Transportation, Supply, and Construction Divisions, QMC, without causing much stir. Most agreed that the idea had merit, but there is no evidence that any action resulted beyond the sending of a copy of the study to the Army War College.[5]

After the maneuvers of 1940, the commanding general of the Armored Force joined the pipeline enthusiasts. But it was not until 1941, when the Motor Transport Division of the Quartermaster Corps began to examine a new concept of gasoline dispensing from railroad sidings, that the theoretical benefits of military pipelines began to approach reality.

On 26 February 1941 the War Department approved the military characteristics of a new gasoline dispensing system submitted by the Quartermaster Corps earlier that month. The QMC proposed to develop a pipeline as the primary means of delivering gasoline from tank cars to can and drum refilling points whenever tank trucks were not available or wherever features of terrain made the use of trucks impractical. All pipe, pumps, engines, hose, tools, and victaulic couplings were of standard commercial design. The pipeline was to extend for a maximum of five miles from railhead to final distributing point and was to deliver about eighty gallons of gasoline a minute.[6]

From March through May the Motor Transport Division laid plans for a five-mile test section of three-inch pipe to be built on the government reservation near the Military Academy at West Point. Two officers and one hundred enlisted men from the Holabird Quartermaster Depot were to construct the line. But during the course of the next few months this complicated project was curtailed. In the end, the pilot model consisted of only a quarter of a mile of pipe installed at the Holabird Depot.

This model was ready for inspection on 30 October. Representatives from the Corps of Engineers, among others, stood on a creek bank and watched the system pump water through 200 feet of hose laid across the creek on floats, and through a three-inch pipeline along the opposite bank to two multiple-hose dispensers. All observers agreed that the pipeline was a success. The Motor Transport Division, by this time completely convinced of the worth of its pipeline, suggested that the line might also be used to refuel planes and to span awkward ship-to-shore distances in the Panama area where docking facilities were not available for unloading barges.

Anxious to give the pipeline a field test, the Motor Transport Division moved immediately to insure that the system would have a tryout during the First Army maneuvers in November. The day following the Holabird test, 2d Lt. Carl D. Becker was on his way to Florence, South Carolina, to select a location for a general test of equipment and for premaneuver training of QMC troops. After his arrival at Florence, Becker decided to break the seven miles of pipe into several units in order to provide

[5] QMC 463.7, Misc, Compiled 1940.

[6] Ltr, Brig Gen J. E. Barsinski to TAG, 15 Feb 41, sub: MCE No. 2–Portable Pipeline Unit, with Incl, MCE No. 2, with 1st Ind, 26 Feb 41. QMC 400.1141, Pipeline, Gasoline Portable.

training under different situations. A complete five-mile system would be laid out later in the month during maneuvers wherever the General Staff dictated.

The site chosen by the General Staff extended from a railhead at Hydro, North Carolina, across the swift Pee Dee River, up the steep bank, and on to a refilling point for the First Army near Norwood. Forty-eight enlisted men from the 56th Quartermaster Regiment, divided into three working parties of sixteen men each, laid the pipe at a rate of one mile an hour. The centrifugal pumps delivered gasoline at the end of the line at a rate of about 4,000 gallons an hour. Supply valves, with three hoses each, could be cut into the pipeline at any coupling for refilling cans.

The QMC realized the potential of the pipeline for discharging an offshore cargo of gasoline but was still too closely tied to the original dispensing idea to see beyond the five-mile goal. One observer recorded his impressions in a magazine published by the Holabird Quartermaster Depot. Struck particularly by the floating section across the river, he attempted to force more ambitious claims from one of the QMC officers in charge:

> The officer pooh-poohed the romantic notion that the pipeline would stretch right up into the front line refueling the tanks and trucks hustling about the fields of combat. "The main use of it," he declared, keeping his feet on the ground, "is to break up the concentration of men, trucks, and fuel containers at base sources of supply. The line will make it easy to establish fuel dumps and keep them well supplied. That's the main use of it." [7]

Godfrey was intrigued by the demonstration and instructed Schull, then executive officer of the 21st Engineer Aviation Regiment, to give the pipeline a thorough inspection. Schull's report from Spartanburg on 30 November was detailed and enthusiastic. The pipeline might well be used for direct refueling of planes at an airdrome from a bulk source of gasoline safely hidden several miles away. He recommended that the 21st make further tests. On Christmas Eve, 1941, Godfrey relayed all of the information he had gathered to the Chief of Engineers, including the rumor that the QMC planned to organize a battalion of four companies around this equipment. Each company would carry four miles of pipe. While granting that "the Quartermaster General has initiated the development of this equipment," Godfrey was of the opinion that the pipeline was "also of interest to the Corps of Engineers." [8]

The Potential Realized by the Corps of Engineers

The Corps of Engineers, since November 1940, had been responsible for purchasing and installing permanent gasoline pipelines and storage tanks at airfields within the United States.[9] By the time Godfrey made his report, portable pipelines were also "of interest" to the Corps, but on a much larger scale than that envisioned by the QMC. In the fall of 1941, just as the QMC prepared to build its pilot model at Holabird, a request from the Chinese Government for lend-lease funds to purchase pipeline equipment precipitated Engineer testing of portable pipelines of heavier caliber. The Shell Oil Company, through Sid S. Smith, had

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[7] Anon., "Portable Pipelines," *Army Motors,* II (December, 1941), 266–67.

[8] 2d Ind, Engr AF Combat Comd to CofEngrs, 24 Dec 41, on Ltr, ExO 21st Engr Avn Regt to CO 21st Engr Avn Regt, 30 Nov 41, sub: Inspec of Portable Pipeline. QMC 400.112, Pipeline, Portable.

[9] (1) 678. (2) Tel Conv, Roland Ost, 25 Jul 55. (3) Tel Conv, George B. Seeley, 25 Jul 55.

been urging since 1940 the construction of a 715-mile pipeline paralleling the Burma Road, but the War Department had refused to listen. Smith then turned to the Chinese and persuaded them to adopt this plan. Shell engineers under the direction of Smith designed a pipeline system for this road using reciprocating pumps and an arrangement of control equipment that had never been tried before, not even by the Shell Company. Smith compiled these plans into a small booklet titled, "Portable Pipe Lines." This was the system which the Chinese requested. Fortunately for those who had been advocating military pipelines, the Shell maneuver with the Chinese stirred interest at top levels, bypassing many who had turned a deaf ear to earlier suggestions.[10]

On 17 September 1941, Smith explained his pipeline system at a conference held in the office of Brig. Gen. John Magruder, Chief, Military Mission to China. Also present, in addition to members of the Military Mission, were representatives from the Corps of Engineers and the Asiatic Petroleum Company, as well as the president of China Defense Supplies, Incorporated. The Corps of Engineers was already deeply involved in defense aid to the Chinese. Procurement of materials had begun for proposed improvements to the Burma Road and for the construction of a railroad to parallel it. This background, coupled with the fact that the installation of such a pipeline along the Burma Road would be essentially an engineering construction job, explained the presence of the Engineer officers at the conference. Maj. Theodore T. Molnar, chief of the Defense Aid Unit, headed the Engineer delegation. To this assembly Smith pointed out the shortage in steel drum production in the United States and the impossibility of getting any drums from the British, who had already obligated for military purposes all steel drums that could be manufactured in Singapore, Rangoon, and other parts of Burma for months to come. The pipeline he described would take up less shipping space than the equivalent drums which would be necessary to move the quantity of motor fuel contemplated. Pipeline equipment would also offer less temptation to the Chinese populace, which had already acquired a taste for steel drums.[11]

The system which Smith described provided for "invasion tubing" grooved for victaulic coupling, and, as Smith asserted, there was nothing untried in the reciprocating pumps or the engines which drove them. The only untried part of Smith's design was his particular arrangement of automatic controls. The petroleum industry, according to Smith, already used similar devices which worked on the theory that "pressures in a pipe line can be used to functionally control the flows in the line so that it can, however long, however complicated, or however unlevel, be turned on and off at the delivery point like a garden hose, meanwhile functionally controlling all of its parts so that no dangerous pressures are generated by its stoppage nor dangerous runaways or voids created by its restarting." The Smith system provided means for slowing the engines and bypassing the flow

[10] Ltr, Karstens to Office of Tech Info OCE, 9 Nov 45, sub: Comments on Pipeline Articles. EHD file, Hist of Dev of Mil Pipelines.

[11] (1) Incl, Rpt of Conf in Magruder's Office Between the WD, Representatives of China Defense Supplies, Inc., and the Shell Oil Co., to Memo, C of Sup Sec OCE for C of Mil Mission to China, 22 Sep 41, sub: Proposed Pipeline To Be Constructed in China. 400.333, China, Pt. 2. (2) Leighton and Coakley, *Global Logistics and Strategy,* pp. 86, 87. (3) See above, pp. 100, 102.

around a station in response to pressures felt at a given point. For the delivery of 4,000 to 6,000 barrels a day over level ground, pumping stations would be installed at 20-mile intervals. Pumping stations were to be mobile so they could be shifted about as the military situation warranted. Smith estimated that provided "sufficient truck and stringing forces are properly organized and trained . . . there should be no difficulty to transport, lay, and have stations operating on up to thirty miles per day." [12]

A few days after this conference, Dr. T. V. Soong, president of China Defense Supplies, Incorporated, wrote to the home office of the Military Mission to China. Technically qualified people had confirmed the merit of the pipeline. Soong now proposed to send someone to Burma to "study local technical problems." He added that "since this pipe line project has been given such favorable consideration by eminent engineers, may we suggest that you refer it to the Chief of Staff of Army Engineers for his thorough study." [13]

General Magruder had already acted. He was uneasy over the fact that the control system was untested. The project involved about $5,000,000 and some 16,000 tons of steel. An investigation should be made before lend-lease agencies gave their full support to a project of this magnitude, involving large amounts of critical materials. On 18 September he requested the Corps of Engineers to make the study, adding that the Shell Oil Company was again presenting this portable pipeline to the Quartermaster Corps "as a rapid means of transportation of gasoline in the field." [14]

After a cursory study, the Engineers expressed considerable skepticism. On 3 October Kingman pointed out to Magruder that this portable pipeline was more complex and was to be laid over more difficult terrain than any of the permanent automatic pipelines then in existence. The forty pumping stations, with six automatic controls each, presented 240 possibilities for control failures. With the use of twenty-foot lengths of pipe with victaulic couplings, leaks could occur at some 200,000 points. Moreover, Kingman believed Smith's cost estimates too low and his rate of laying too optimistic. But he admitted that the line "appears to have sufficient merit, technically, in the opinion of the Chief of Engineers, to justify further investigation. A list of pipe line authorities has been prepared for consultation if such further investigation is assigned to the Chief of Engineers." [15]

Within the first few weeks of 1942 the Japanese invaded the Netherlands Indies, the capture of Singapore was imminent, and the closing of the Burma Road was a matter of time. The military situation, coupled with the critical attitude of the Corps of Engineers toward the Smith system, caused Magruder to stop all action on the project on 21 January.[16] Smith, however, having got so far, was not easily discouraged. The Burma Road had been uppermost in his mind before, but after the United States formally entered the war he turned his

[12] Pamphlet, Portable Pipe Lines, Shell Oil Co., Inc. (1941). EHD files.

[13] Ltr, President China Defense Supplies, Inc., to Col H. W. T. Eglin, 26 Sep 41. 400.333, China, Pt. 2.

[14] Memo, Magruder for CofEngrs, 18 Sep 41, sub: Oil Pipeline for Burma Road. 400.333, China, Pt. 2.

[15] 1st Ind, Kingman to Magruder, 3 Oct 41, on Ltr, Magruder to OCE, 18 Sep 41, sub: Oil Pipeline for Burma Road. 400.333, China, Pt. 2.

[16] (1) Memo, Eglin for CofEngrs, 21 Jan 42, sub: Gasoline Pipeline—From Bhamo, Burma, to Kunming, China. 400.333, China, Pt. 2. (2) Ltr, Molnar to C of EHD, 28 Jul 55.

efforts toward proving that his pipeline system was simple enough and rugged enough for general military use. The Chinese, despite Magruder's attitude, maintained an active interest.

In March, Smith invited the Corps of Engineers and the Chinese to send representatives to the East Chicago plant of the Shell Oil Company, where he had set up a pilot pipeline. This step proved to be the turning point. Baker, from the Engineer Board, laid plans at once for a large-scale test. On 8 April he proposed to OCE that the board build a 30-mile line of 4-inch pipe, complete with pumps and automatic controls.[17]

The matter was then up to OCE. Fowler favored the project, visualizing at once the possibilities. "This scheme, if workable," he noted to Chorpening on 10 April, "has great military value. The rate of installation would keep up with any reasonable offensive and thus take a lot of traffic off the roads." [18] But the question for immediate decision was whether this test should be combined with the purchase of pipeline equipment for the Chinese. Fowler thought it should.

> If the Chinese will have a place to lay the line by the time we can get it fabricated, we should order it at once, provided it has a reasonable chance of being shipped and working satisfactorily. . . . I believe this pipe line may mean much to the Chinese Army this year and that, if tested immediately as manufactured, any mechanical defects can be corrected before shipment.
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> The Board should acquire the pipe, pumps and other equipment for test immediately. If purchased as part of the Chinese order, time and production costs will be reduced. The time for laying 30 miles of pipe is negligible. Two weeks of continuous operation should bring out the worst bugs. The Board should therefore be able to recommend changes within 30 days of delivery of the test equipment and the changes incorporated in later deliveries of the Chinese order. . . . I would say that we would be taking a small gamble in cost of alterations if we place the Chinese order now with the possible advantage of keeping the Chinese Army on its feet until more substantial help can arrive. Should the Burma Road be captured by the Japs this year, we would still have the pipe line to support some other force.[19]

Although Rangoon had just fallen to the invading Japanese, diminishing the likelihood that the Chinese would ever build a pipeline along the Burma Road, OCE decreed that the experiment should go through without delay. The Engineer Board, acting upon oral instructions from Chorpening, obtained on 11 April a quotation from Hanlon-Waters, Incorporated, of Tulsa, Oklahoma, on four pumping units and thirty miles of pipe. Confirmation of procurement authority came on 15 April.[20] On 30 April, Besson, chief of the Development Branch, outlined in more detail what the board was to do. Specifying that "the tests will be performed as an Engineer Board study in connection with the procurement of portable pipelines for the Chinese Government," he indicated there would also be a broader purpose. "Tests on the pipeline should include investigation as to the suitability of the operation by troop labor, speed of laying and moving the line, dependability of automatic control devices, and general suitability of all the component parts of the

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[17] (1) Ltr cited n. 16 (2). (2) Ltr, Baker to Molnar, 8 Apr 42, sub: Preliminary Rpt on Portable Pipeline for Fuel Oils. 400.112, Pipelines.

[18] Memo, Fowler for Chorpening, 10 Apr 42, sub: Preliminary Rpt on Portable Pipeline for Fuel Oils. Intnl Div file, 678.

[19] *Ibid.*

[20] (1) Memo, Baker for Besson, 11 Apr 42, sub: Portable Pipeline Test. 400.112, Pipelines. (2) Ltr, Actg C of Sup Div to President Engr Bd, 15 Apr 42, sub: Portable Pipeline. 400.333, Pt. 3.

complete system." [21] The Engineers were ready to test a pipeline for general military use, Quartermaster Corps responsibility to the contrary.

The board placed in charge of the tests Chauncey W. Karstens, one of its associate engineers then assigned to the Water Supply Branch. In May 1942 Karstens, an Engineer Reserve officer, was ordered to active duty as a first lieutenant and became head of a newly formed Pipeline Equipment Section. Assisting him were 1st Lt. Ernest A. Slade, who had previously manufactured control devices for pipelines, 2d Lt. Kenneth L. Treiber, who had worked for nine years on pump designs and hydraulic problems, and John Elder, an employee of the board's Bridge Section, who had previous experience in installing pipelines.[22] OCE was particularly interested in determining whether or not the automatic controls would relieve the system if it were subjected to high static pressures. To this end, Besson suggested a testing site in the mountains of the Shenandoah National Park in Virginia.[23]

For a number of reasons, Karstens favored the use of troops rather than civilian labor on the project. The labor force would consist of types and grades of men to be expected in the field, it would be stable, and it would be subject to discipline. Estimates of construction time and recommendations regarding personnel would thus be more accurate. The work would provide valuable training. Karstens estimated that one company of a general service regiment would be required. But troops could not be spared for such work in the spring of 1942. After making a detailed survey of the site, the supervisory staff on 30 June set up camp on the Rapidan, near Herbert Hoover's fishing lodge, and began hiring civilian labor.

Meanwhile, a request from the European Theater of Operations had channeled the question of petroleum distribution toward a more definite objective. On 5 June, Clay of SOS asked the Engineers to make a study of means for supplying gasoline for the projected invasion of Europe.[24] On 1 July, OCE cabled SOS, ETO, as follows:

> Until a front is consolidated, approximately 30 miles inland, the supply will be in cans and drums for the first phase. During the second phase, supply will be made through pipeline to shore tanks by tankers. Light-weight and rapidly constructed pipelines which can easily be carried by men and laid at the rate of 20 miles or more per day will be used. Distribution from tanks will be made to six or more light-weight pipelines. To allow inter-connection and spread distribution, lateral lines will be laid at strategic points inland.[25]

This plan fitted in exactly with the thinking of British and American officers in England, where the development of military pipelines had been underway since the German break-through in France in May 1940. In fact, upon the very day OCE sent the cable to SOS, ETO, a cable incorporating the same general plan of distribution crossed the Atlantic in the opposite direction, from the British War Office to the British Army staff in Washington. By July, both OCE and the Engineers in the United Kingdom had

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[21] Ltr, C of Dev Br to President Engr Bd, 30 Apr 42, sub: Test of Experimental Pump Equip. 412.3, Pt. 2.

[22] Engr Bd Hist Study, Pipeline Equipment, p. 12.

[23] Ltr, C of Dev Br to President Engr Bd, 20 Apr 42, sub: Test of Experimental Pump Equip. 412.3, Pt. 2.

[24] Ltr, AC of O&T Br to Deputy CofS for Rqmts and Resources SOS, 17 Jun 42, sub: Gasoline Sup Plan for BOLERO. P&T Div file, 381, BOLERO, Folio 1.

[25] Quoted in Hist Rpt 13, Liaison Sec Intel Div, Office of C Engr ETO, Petroleum-Oil-Lubricants, p. 6. AG Special Collection, Opn Rpts.

begun to think in terms of a military organization to lay and operate the pipeline.

OCE was reluctant to make any recommendation until it had some evidence from the experimental tests in Virginia. A pipeline expert would be necessary to evaluate the experience and translate it into terms of men and equipment. For this job, OCE obtained Edson W. Berlin, in July 1942, from the construction department of the Socony-Vacuum Oil Company, Incorporated. To determine the best organization for the work, Berlin became a frequent visitor to the test site in the Shenandoah National Park.[26]

The first carload of pipe arrived at the park on 8 July and stringing it began immediately. With a crew that varied from ten to thirty-five, it took eighteen working days to install the first sixteen and a half miles of the system, complete with four pumping stations. On the whole, the process of installation proved simple. Contrary to expectations, a number of local farmers applied for jobs at laying and operating the test line. They proved willing and able workers, and the fact that they possessed little or no mechanical experience served to gauge the amount of time it might take to train similarly inexperienced troops. The main difficulty in laying the pipe was with defective couplings. The products of three manufacturers were installed. At first only those supplied by the Victaulic Company provided the tight fit necessary, but in a short time the Guston-Bacon Company remedied its product so that it, too, was completely satisfactory. By 1 August, Smith was on hand to supervise the adjustment of the automatic controls. The system was ready for operation.

The Corps of Engineers had by this time gone far beyond the original purpose—to test a pipeline for the Chinese. The distribution of petroleum products to the Army was a responsibility of the Quartermaster Corps. On 28 July, SOS held a conference to clear up the confusion. In effect, the *status quo,* based upon equipment either developed or under test, became official doctrine. The QMC would henceforth supply and maintain "portable pipe lines used in issue of gasoline," including dispensers and pumps. The Engineers would construct and operate "all pipe lines and storage facilities of permanent or semi-permanent nature." [27] Since the QMC considered anything larger than its three-inch pipe "semipermanent," this agreement amounted to an abdication by the QMC of any major role in petroleum distribution by pipeline. On 7 August The Adjutant General's Office elaborated upon this agreement. The Corps of Engineers was to make connections with floating cargo, erect storage tanks near the shore line, and from that point advance pipelines and storage facilities as the tactical situation permitted. The Quartermaster Corps would carry on from there with three-inch dispenser systems. By 17 September, when the War Department made a formal restatement of the development responsibilities of the various services, pipelines were allotted to the Chief of Engineers; dispensers went to the Chief of Ordnance.[28]

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[26] Ltr, Actg C of Dev Br Sup Div to President Engr Bd, 25 Jul 42, sub: Portable Pipeline. 400.112, Pipelines.

[27] Memo, Dir Opns Div Motor Trans Sv to Supply Div Motor Trans Sv, 29 Jul 42, sub: Responsibility in Trans and Storage of Liquid Fuels in Overseas Opns. QMC 463.7, Cross References Only, 1942.

[28] (1) Ltr, TAG to CGs AGF, AAF, SOS, *et al.,* 7 Aug 42, sub: Responsibility for Proc, Maint, and Opn of Gasoline Dispensing Facilities Overseas. QMC 463.7, Cross References Only, 1942. (2) WD Cir 317, 17 Sep 42.

Testing Equipment

Now vested with authority, the Engineers continued their experiment in the park. Once full-scale operations began, bugs in the pumping stations became apparent. The pistons of the reciprocating pumps wore out, causing frequent shutdowns for repairs. The group at Rapidan lost all faith in the Smith combination of reciprocating pumps and elaborate controls and safety devices. Treiber was sure that centrifugal pumps with manually controlled stations would be safer and more practical for a military pipeline. Part of the complication of the Smith system lay in trying to make a reciprocating pump do the work of a centrifugal pump. While reciprocating pumps build up pressure indefinitely until some part of the system gives way or a relief mechanism takes over, centrifugal pumps build up pressure only to a certain point and then churn without danger. Treiber therefore urged the substitution of the lighter, safer, pickup centrifugal pump, commonly called PUP, manufactured by the Byron-Jackson Company. With this pump, no automatic controls would be necessary.

There was no question but that the automatic controls were the most troublesome part of the system. They were almost constantly in need of adjustment. "In general," wrote Karstens on 30 September, "control performance has not come up to expectations. To adjust so that the desired performance is attained is one thing, but to retain such adjustment is another matter. . . . It is felt the system will work, but the question arises as to whether it is a little too complex for military field use." [29] The automatic controls were "too sensitive to minor misadjustments." Their use would require "the continuous attention of expert operators to maintain a uniform throughput rate under field conditions." [30] In strong support of Treiber and Karstens against the Shell Company's control system was Dr. Lester M. Goldsmith, vice-president of the Atlantic Refining Company of Philadelphia and chief engineer for the 24-inch cross-country pipeline, popularly termed the "Big Inch." Goldsmith was emphatically against the complicated control gadgets and spoke out vigorously for manual control of all stations and for centrifugal pumps. With this additional backing, Karstens recommended that the automatic controls be abandoned.

Some centrifugal pumps without automatic controls were ordered during the operations at the park but were not delivered in time to be tested there. Subsequent tryouts at Belvoir indicated that this type of pump, with some modification, would be well suited to the job. But the total industrial capacity for centrifugal pumps was at this time allotted to shipbuilding programs and the Engineers had to be content for some time with reciprocating pumps. Later, when some centrifugal pumps became available, the Engineers ordered them in great numbers. Despite the fact that the PUP did not turn out to be as sturdy as it should have been for continuous operation, the troops preferred it to the reciprocating type, even though in the end the latter was also manually operated. Since both were used, training in operation and maintenance had to be provided for both types.

[29] Memo, Engr Bd for C of Dev Br, 30 Sep 42, sub: Opns of Pipeline Sec, 14 Sep–20 Sep 42. ERDL file, EB 143.

[30] Rpt, Karstens [Dec 42], sub: Test of Smith Type Portable Pipeline. Mech Equip Br file, Portable Pipelines.

Taken as a whole, the park experiment showed that a pipeline system would prove a great boon to military operations. This conclusion, and similar encouraging reports made while the tests were in progress, served to confirm the Engineers in the course upon which by this time they were fully launched. Orders for pipe and pumping stations for the North African operation as well as for the build-up for BOLERO had been placed even as the tests were in progress. By mid-October, when testing at Shenandoah Park was discontinued, plans for the organization and training of petroleum distribution units were being worked out.[31]

The Engineers in Britain had at first thought in terms of a battalion for this work and drew up a tentative T/O on 12 August 1942. Concluding shortly that this unit was unsatisfactory, they drew up another T/O based upon a general service regiment. Objections to the size of this organization led to a compromise T/O on 13 September for a unit the size of an aviation battalion. Meanwhile, on 10 September, OCE submitted to the General Staff a T/O for a pipeline regiment. This was rejected on the ground that the organization of specialized regiments should be avoided if a standard unit augmented by a company or smaller unit could be used. In line with this policy ASF directed the Engineers to prepare a table for a company to augment a general service regiment. The first four petroleum units that were activated were finally designed as detachments, which when attached to general service regiments could construct and operate a 260-mile pipeline system. These organizations did not have regular T/O's, but were activated with special personnel charts.[32]

In October the Engineer Section of SOS, ETO, asked for additional investigations into methods of laying a ship-to-shore pipeline. Such sea-loading line would free an invading force from dependence upon supply by cans and drums in the absence of docking facilities, and would, the Engineers anticipated, be the usual means of distribution during the second phase of an invasion. With the coastal currents of the English Channel in mind, the Engineer Section, ETO, asked that heavy drill pipe be launched in a four-knot crosscurrent. The U.S. Coast and Geodetic Survey suggested several possible sites, one of which was an area off the north shore of Martha's Vineyard, Massachusetts. Among other desirable features of this location was the fact that it was near Camp Edwards, the headquarters of the Engineer Amphibian Command, which readily agreed to furnish men and equipment for the tests.[33]

While a decision about the site was being made, Colonel Berlin's Petroleum Section in OCE collected suggestions from petroleum companies and construction engineers on how to conduct the operation. At

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[31] (1) Memo, C of Mob and Tng Sec for Maj Holt, Rqmts Br, 6 Aug 42, sub: Pipe Couplings for TofOpns. 412.2, Pt. 2. (2) Ltr, C of Sup Div to CG SOS, 23 Sep 42, sub: Portable Gasoline Pipeline Equip. 400.112, Pipelines. (3) Ltr, C of Engr and Dev Br to President Engr Bd, 15 Oct 42, sub: Tng of Pipeline Pers, with 2d Ind, AC of Engr and Dev Br to President Engr Bd, 9 Nov 42. Mech Equip Br file, Pipelines, Bk 2. (4) Ltr, A. D. Small to Capt Mesle, Office of Tech Info, 26 Nov 45. EHD file, Hist of Dev of Mil Pipelines.

[32] (1) Ltr, Actg C of Dev Br to President Engr Bd, 25 Jul 42, sub: Portable Pipeline. 400.112, Pipelines. (2) 1st Ind, 25 Sep 42, on Ltr, OCE to SOS, 10 Sep 42, sub: T/Os for Engr Pipeline Regt. AG 320.3 (10–30–41) (2) Sec. 5, Bulky Package. (3) Incl 2, with Ltr, Hq EUTC Claiborne to CofEngrs, 1 Jan 43, sub: Capacity of EUTC. 320.2, Claiborne (C).

[33] Memo, C of Mob and Tng Sec for C of Sup Div, 6 Oct 42, sub: Test of Submarine Sea-Loading Line and 4-Inch Pipeline. 400.112, Pipelines.

a meeting attended by Berlin, Karstens, Elder, and other interested persons on 3 April 1943, the Petroleum Section presented four methods which it had culled from the responses: (1) assembly from barge or landing craft; (2) assembly on land followed by floating line into position by various combinations of pulling and pushing; (3) assembly on land and moving line into position with amphibian trucks; (4) assembly on land and pushing along sea bottom with aid of tow. When it came to details, however, commercial practices differed sharply from those required in a military operation. Industry's objective being permanency, speed of construction was sacrificed. Slade and Elder, the board's representatives at Martha's Vineyard, and Karstens, their chief, learned somewhat more from a description of British experiments. But by and large these men were pioneers and were conscious of being so.

Men and materials began to arrive for the tests during the second week in May, and laying of pipe began the week after. The weight of the pipe—over 624 pounds per section—made it difficult and dangerous to handle. Although mechanical lifting devices could be used to some extent, final alignment had to be accomplished by manpower. It took sixteen men to lift one section of pipe. The sections were joined by screwing, since the victaulic coupling was not strong enough for this pipe, and welders with sufficient skill to join heavy wall pipe were rare in the Army. Such pipe had been selected by Berlin because of its ruggedness, durability being important because of underwater stresses. Leaks under water would not only be more likely to occur than on land but would be more difficult to locate and repair. However, after noting that it took 32 men seven hours to connect 35 joints of pipe, those conducting the tests questioned whether the advantage of ruggedness was not outweighed by the time consumed. If welders could have been trained or made available the work would have been accomplished more quickly. In the absence of such skilled men, the group at Martha's Vineyard could only recommend a compromise. The lightweight "invasion tubing" would not suffice, but standard weight victaulic-coupled pipe could be used in crosscurrents of less than two knots.

All pipelines at the Martha's Vineyard tests were assembled on land. Assembly from barge or landing craft was not attempted. All four methods of launching worked but none was suitable for every situation. Attaching floats to a pipeline laid parallel to the shore, pushing the line into the surf with a bulldozer, and towing into position with an LCT proved fastest. But the fourth method proved to be the best. Two 5,000 pound anchors were lowered into the sea and attached to a winch line mounted on the forward end of a barge and the sea-end of the pipeline was attached aft. The barge was then winched toward the anchors, pulling the pipeline after it with the aid of tractors on shore. Because of slippage of the anchors during the tests, only 2,680 feet of pipe could be launched, but Slade and his assistants believed that with improvements in details of technique almost twice this amount could be handled. This type of launching, although complicated, was superior to the others because the pipeline was under closer control and the equipment required a draft of only three feet. The testing staff at Martha's Vineyard recommended that this method be used where shoals or reefs existed, in areas where

there was not space enough to assemble the complete pipeline on land, or in case the line had to be laid on a prescribed course.

Training Petroleum Distribution Companies

As with many other specialties, the Engineers did not at first contemplate any great amount of enlisted instruction in pipeline installation and operation, relying instead upon securing sufficient enlisted personnel with previous civilian experience. The experimental pipeline in the Shenandoah Park was to be used only for training a limited number of officers.[34] But it became apparent during the course of the testing in Virginia that troop training would be necessary after all. The Smith system included some features which would be unfamiliar even to experienced petroleum men, who would in any case have to learn to apply their knowledge to military situations. Accordingly, on 15 October the Engineers began the organization of two petroleum distribution detachments and OCE directed the Engineer Board to work out a short training program for these special troops. The testing officers recommended that the experimental pipeline system be removed to some southern location with adequate housing and supply facilities where there would be no necessity for winterizing the equipment. Since additional testing remained to be done, the board at first ordered the system installed at Belvoir, but by early November the original recommendations of the testing officers prevailed. Future testing would be conducted at the Claiborne EUTC. At the same time, the two petroleum detachments would train for early service overseas.[35]

The Engineers organized the Petroleum Section at Claiborne on 9 November 1942 under Maj. James L. Lake, Jr., with a staff of ten officers recruited from various War Department agencies. All of these men had civilian experience in the petroleum industry. Slade and Treiber, from the Engineer Board, remained for a short time on temporary duty. OCE retained close control over the section through the formative period of organization and testing which lasted through most of December. Berlin remained technical director of its activities. Elder, meantime, supervised the building of the first troop-constructed pipeline at the Desert Training Center near Yuma, Arizona, and contributed materially to knowledge of troop capabilities, heretofore based on scanty estimates.

The first four detachments which began to train in November and December 1942 were handicapped by the conditions at Claiborne. West Claiborne was still a tent camp with no buildings available for offices, classrooms, or shop maintenance work. Mess halls, chapels, and open fields served as classrooms. The experimental pipeline system brought from the Virginia testing ground and set up next to the EUTC demolitions area required continuous adjustment of the delicate and impractical automatic controls. Until the latter part of December, canvas water tanks had to be substituted for the metal bolted tanks which these units

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[34] (1) Memo, C of Sup Div for SW, 7 Sep 42, sub: Use of the Shenandoah National Park for Tng Officers for Pipeline Bns. 353, Engr Petroleum Distr Units. (2) Ltr, SW to Secy Interior, 10 Sep 42. USW file, Misc and Subject, Pipe, Pipelines, etc.

[35] (1) Ltr, Adj EUTC to CofEngrs, 16 Dec 42, sub: Capacity of EUTC, with Incl 1, List of Units Now in Tng at EUTC. 353, Claiborne (C). (2) Ltr, C of Engr and Dev Br to Engr Bd, 15 Oct 42, sub: Tng of Pipeline Pers, with 2d Ind, AC of Engr and Dev Br to Engr Bd, 9 Nov 42, with Incl, Outline for Course of Instr for Mil Portable Pipeline. Mech Equip Br file, Pipelines, Bk 2.

were supposed to be able to construct. Conventional 2½-ton trucks were poorly designed for handling pipeline, and time had to be taken to convert ten of these by moving the winch from the front to the rear of the cab and adding a gin pole to the rear. A tentative technical manual in mimeographed form, completed by Slade and Smith at the end of October 1942, mentioned the PUP centrifugal pump but emphasized the reciprocating pump with automatic controls. Not until early in 1943 was Treiber detailed from Claiborne to Washington to revise and expand these original papers into a permanent manual. Still firmly convinced of the practicality of the centrifugal pump, Treiber insisted at that time upon inserting a chapter on the operation and maintenance of the PUP—eventually one of the most valuable chapters in the manual. Meanwhile, at Claiborne, training and testing programs and procedures were worked out and explanatory drawings and other training aids were improvised and improved.[36]

Although the first units that trained in the Petroleum Section filled slowly and training was delayed and sometimes shortened, they performed well overseas because they were composed largely of men from the oil fields. War Department policy prevented the enlistment of men between the ages of eighteen and thirty-eight but the Engineers obtained qualified men through the cooperation of numerous oil companies which supplied names of former employees who were in the Army. Such men could then be located and transferred. Civilian firms continued to aid the Engineers by advising their men when they came up for induction to contact OCE for details of a plan which would enable them to go directly from reception centers to petroleum distribution units. The supply of such men gave out much sooner than was expected. Later units were handicapped by inadequate civilian background.[37]

By the end of 1942 the Petroleum Section had set up the training program which it used through the spring of 1943. Each unit took its basic military training under the direct control of the EUTC and then transferred to the Petroleum Section. For two weeks all enlisted men took a primary orientation course which included an explanation of the purpose and probable missions of the unit, the ratings that would be open to those who qualified, the equipment which would be used, and some practical work on the construction and operation of pipelines. On the basis of an examination at the end of this course the men were divided into smaller groups of about forty each for specialized training. For greater flexibility in assignment and to provide for emergencies, each man received training in two types of work which included the operation of pump stations, pipe laying, the maintenance and repair of pumps, engines and controllers, and the erection of bolted steel tanks. Through the spring of 1943 most of this training was given within the EUTC area on a fixed pipeline system of eight pumping stations and the equivalent of eighty miles of pipeline. As in the Shenandoah Park, water rather than petroleum flowed through the system. To simulate the operation of a longer line, smaller pipe offering a higher resistance to

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[36] (1) Ltr, C of O&T Br to Lake, 23 Nov 42, sub: Pipeline Tng Sch, EUTC Camp Claiborne, La. 353, ASFTC Claiborne, Pt. 1. (2) Technical Manual (Tentative) Portable Pipeline Systems, 1 Nov 42. EHD files. (3) Tel Conv, Treiber, 5 Jul 55.

[37] (1) 220.3, Engr Petroleum Distr Units. (2) Memo, G–3 for CG ASF, 28 Mar 44, sub: Tng of Engr Pers. 353, Engrs. (3) Draft of Memo, OCE for Dir Mil Tng Div ASF [1 Apr 44], sub: Tng of Engr Pers. 353, Engrs.

the flow of liquid was introduced. The area devoted to steel tank erection had six tanks of 250-barrel capacity each. In March 1943 the Petroleum Section obtained a theater of operations type of shop building in which to give instruction in maintenance and repair. Officers and key men made occasional trips to hilly country nearby in order to obtain barometric pressure readings for profiling theoretical pipeline systems and determining the locations of pumping stations. Most of the officers for the first units were well qualified for their jobs, needing only a short, intensive course on their specific duties. The first class began on 14 December 1942 with twenty-one officers. Subsequent enrollment ranged up to thirty-five, with each class running for about four weeks. Although there was some practical construction and operation, the main emphasis in officer training was upon theory, design, and organization.

Few of these units were organized until the spring of 1943. The first two detachments activated in October 1942 moved overseas in January, leaving at the EUTC only the two units activated in mid-December. No others began training until May 1943, after OCE and ASF settled their divergent views on organization. In March 1943 Berlin had expressed dissatisfaction with the detachment type of unit, tied to a regiment, and recommended the establishment of an independent company. He maintained that with 20 percent less personnel than the existing detachment and without the aid of additional manpower a company could construct and operate 120 miles of pipeline. As finally approved in May 1943 the engineer petroleum distribution company consisted of 7 officers and 221 enlisted men, divided into a headquarters platoon and an operating platoon. With organizational differences finally settled, it became necessary to start a greatly accelerated training program. By May, when the accelerated training began, Capt. Roe Gray had supplanted Lake as head of the Petroleum Section.[38]

As estimated in April 1943, at least four petroleum distribution companies would have to begin training in May and two each month thereafter for the rest of the year. With an average of twenty weeks or more training then envisioned, about ten companies would be in training at all times. Gray had to double the capacity of the fixed petroleum training area within the EUTC. More equipment had to be obtained for unit assembly and disassembly in some area outside the EUTC.

By early July 1943, Gray had enlarged the existing fixed system by adding one station and ten more miles of pipe and had installed another complete fixed system of seven stations and the equivalent of seventy miles of pipe on the adjacent former demolitions area. For field training he obtained two sets of unit equipment and additional pumps and pipe. The companies that trained after July had two weeks of field experience with their own unit officers in charge. Each transported a twenty-mile pipeline system from the EUTC to a training area near Claiborne. There each unit connected this pipeline onto a permanently installed twenty-mile system and operated the full forty miles with various rates of

(1) Ltr, O&T Br to ACofS for Opns SOS, 16 Mar 43, sub: Proposed T/O for Engr Petroleum Distr Unit. 320.2, Engr Petroleum Distr Units. (2) Office Memo, Berlin for Plans Div ACofS for Opns ASF, 19 Mar 43, sub: Rev T/O Engr Petroleum Distr Det. 320.2, Secret File 2. (3) T/O&E 5–327, 14 May 43. (4) FM 5–5, 11 Oct 43, pp. 174–79. (5) EUTC Highlights, 12 Apr 43, with Incl, Prov Orgn of Units, EUTC, 12 Apr 43. 320.2, ASFTC Claiborne.

flow, pressures, and temperatures. The twenty-mile system was then dismantled by the same unit and returned to storage at the EUTC for use by the next company. Since the topography was scarcely different from that of the fixed system in camp, and water was the liquid used, there was little realism in this field training.[39]

The training of most of the units took place during the period when equipment became more plentiful, but the manpower shortage was beginning to be felt. The Petroleum Section obtained training facilities sufficient for both fixed and field training for two new companies each month. Staffing the section called for ingenuity. In 1942 the section had been under the control of OCE, and part of its instructor personnel had been on temporary duty from the Engineer Board. Until OCE and ASF agreed upon the organization of these units in April 1943 there had been few such companies organized and the EUTC had placed only one officer from the section on its permanent staff. Ten others were kept indefinitely in the officers' pool at the center. Officer and enlisted assistants were also on a temporary basis. Units that finished technical training provided instructors for succeeding ones. With activations doubled, field training added, and organization settled, the section in May requested a permanent allotment of 25 officers and 125 enlisted men for its staff, 15 officers and 8 enlisted men for instructors, and the rest for maintenance and administration. Before the personnel could be allotted to the EUTC, the ASF directive of 11 June 1943 restricted the total personnel in training overhead and prohibited the use of pool officers for operational purposes. If rigidly applied, the directive would have stripped the section of all personnel but Gray. The directive had one loophole—additional personnel could be authorized for new or expanding activities. Upon this basis the EUTC finally gained a small increase in July. Qualified officers who had been procured for this particular work were allowed to remain in the pool until permanently assigned. The directive in effect curtailed training to specifically prescribed activities, allowing little experimentation.[40]

Activations ran far ahead of the April estimates. Gray learned in August that he must train twenty-two units by March 1944. Twelve had to be ready for overseas service by the end of 1943. Nine were urgently needed in CBI. A total of five companies in nine months had been trained and sent out from Claiborne by August 1943, leaving seven others which had been organized but not yet completely filled. Fifteen additional units were scheduled for activation during the month of August. Actual training of the twenty-two units was to be more gradual, however, since the pipeline school was not large enough for such numbers. One company was to begin each week, from August through mid-January, on an intensive six-

[39] (1) Memo, Brotherton for Gorlinski, 28 Apr 43, sub: Activation of Engr Petroleum Distr Units. P&T Div file, Inspec Camp Claiborne. (2) Memo, C of O&T Br for CG ASF, 19 May 43, sub: Increase in Allot of Commissioned and Enl Pers for the EUTC Camp Claiborne, La. 320.21, ASFTC Claiborne. (3) 2d Ind, ExO EUTC to CG Eighth SvC, 8 Jul 43, on Ltr, C of Mil Pers Br to CG Eighth SvC, 24 Jun 43, sub: Employment of Pool Offs at EUTC Camp Claiborne, La. 320.2, Engr Petroleum Distr Units. (4) Ltr, S–3 Petroleum Sec to S–3 EUTC, 9 Oct 43, sub: Pipeline Tng—Fld Problem Sched with Incls, Pipeline Tng Sched and Plan for Activating Fld Problem Routes. EHD file, Petroleum Units.

[40] (1) Memo cited n. 39 (2). (2) ASF Cir 39, 11 Jun 43. (3) Ltr, CG EUTC to C of O&T Br, 6 Jul 43. 320 21, ASFTC Claiborne. (4) Ltr, CG EUTC to C of O&T Br, 17 Jul 43. 320.2, ASFTC Claiborne.

PREPARING FOR FIELD PROBLEM ON PIPELAYING, *Camp Claiborne. Men of an Engineer Petroleum Distribution Company load 4-inch pipe on a trailer.*

week program in order to have all of the companies prepared by March 1944.[41]

Such a tight schedule could not be maintained without the closest co-operation in providing fillers with proper qualifications at the exact times needed. To insure the early readiness of these units, Somervell directed that extraordinary efforts be made to fill them with experienced petroleum men, screened from the Army at large, and that all fillers should have completed thirteen weeks of basic training. Screening for these men began in early August but suitable fillers did not arrive. By the first of September the whole schedule was three weeks behind. Only fifty fillers had been received, and only twenty-nine were qualified for this duty and had as much as nine weeks or more basic training. Few were basically trained as engineers. Even if they had completed basic instruction in another branch of the service, the EUTC estimated that it would take another two weeks to qualify them as basic engineer soldiers. Many had not fired the rifle qualification course or the carbine familiarization course. None had any instruction in crew-served weapons and none had gone through the infiltration course.

A new schedule had to be drawn up on the basis of the fillers that this first screening produced. It allowed two weeks to make up military deficiencies, six weeks for pipeline training, and one week for processing. This was the bare minimum which the center believed would get the units past inspection. However, it was essential that five of the CBI units meet an early November sail-

[41] Ltr, CG EUTC to CofEngrs, 2 Aug 43, sub: Recommendations, Activation and Tng of Twenty-two Petroleum Distr Cos, with Incl 1, Proposed Sched of Activations. 322, Engr Petroleum Distr Units.

ing date. Only one would be ready at the proper time. Training for the other four units had to be further modified. Since the first and simplest task would be pipe laying, these four trained for this duty alone. The remainder of their instruction on pumping stations, tank terminals, and warehouses had to follow in the theater, with some instruction given on the troopship en route. Each of these four units left fifty-six specialists behind for an additional month of training at Claiborne. In answer to an anxious query from O&T on the status of the five CBI units, the EUTC replied it "would get them out, but that they should not be expected to be *good* units, as the training time necessary was not available to us." [42]

By January 1944, twelve of the twenty-two petroleum companies were ready for duty as originally planned. Three went to Europe and nine to CBI. Nine out of the remaining ten made the March deadline, one being delayed until April. Four of these ten went to CBI and three each to Europe and the Southwest Pacific. By June a total of thirty companies, or approximately 6,270 men, had trained at Claiborne. Six more companies organized by the spring of 1944 left the center for a port of embarkation by August.[43]

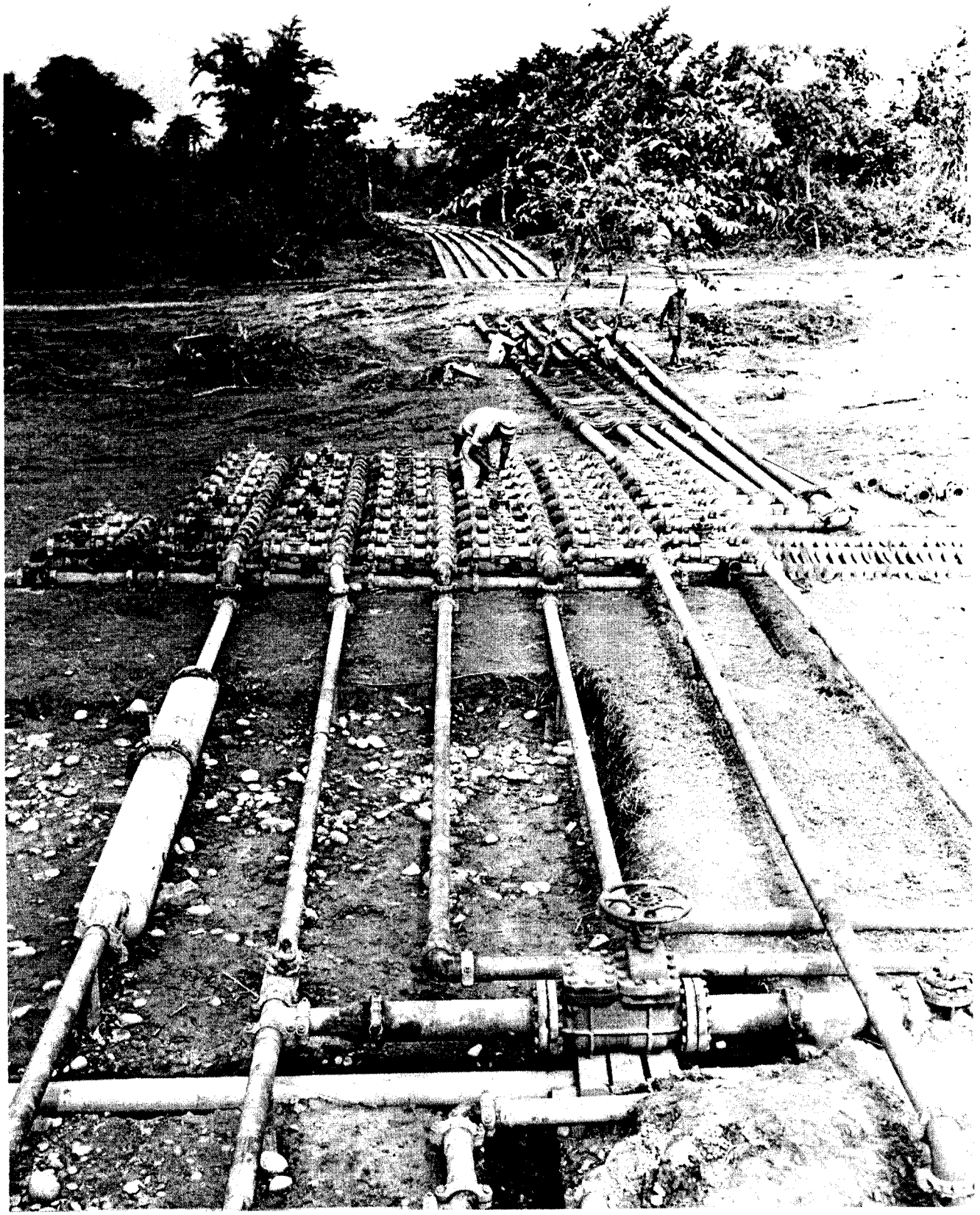
The short course at Claiborne could not prepare men with little previous experience for full and accurate participation in either the construction or operation of pipeline systems. All theaters complained of dirty pipe joints, loose couplings, and debris inside the pipes. The lack of large bodies of water at Claiborne limited exercises in river crossings and the laying of submarine lines—both important operations overseas. Until 1944 there was not enough practical work in the erection of tanks. Although safety precautions and practices were stressed at the center, the training at Claiborne was done with water, not 100-octane gasoline. Consequently, many of the men overseas continued to act as if they were still operating with water, with little realization of the extreme hazards. Beginning in early January 1944, one officer and fifteen men from each company were required to attend a ten-day course at the fire fighting school at Camp Pontchartrain, Louisiana. Conservation of bolts, nuts, and gaskets and the care of tools and equipment were well covered in the short time available. Discipline in the field was another matter. By 1944 there was general agreement that pipeline training could stand considerable improvement—but only at the expense of increasing the training time.

No theater had enough pipeline troops for optimum construction or operation. Because of the initial procrastination in training these companies, theater commanders had to accomplish pipeline work with engineer troops that had not been trained for the job. Engineer general service regiments, engineer dump truck companies, and quartermaster truck companies were continuously pressed into service, as well as native and prisoner labor. Construction delays, frequent repairs, and wasted fuel resulted.

The most serious deficiency proved to be the inability of the units to construct lines at the maximum rate of advance of the mobile forces that depended upon them. In the

[42] Memo for File, S–3 EUTC, 13 Oct 43, sub: Tel Conv with Gorlinski. S–3 Memos for File, EUTC Claiborne, 1943–44. EHD files.

[43] Analysis of the Present Status of the War Department Troop Basis, 1 Jan 45, pp. 214, 215. AG Special Reference Collection.



MANIFOLD VALVE INSTALLATION ON PIPELINE *paralleling the Ledo Road, China-Burma-India Theater, September 1944.*

WELDER JOINING TWO SECTIONS OF PIPE *on petroleum pipeline, France, September 1944.*

CBI, pipeline troops experienced no difficulty in keeping up with the slow pace of military operations, but in the European theater it was another matter. Many of the units employed were not seasoned pipeline companies. The port of Cherbourg, through which most of the vital oil was to be piped inland, was not secured as soon as planned. The supply of pipe and other construction materials was not well co-ordinated. Communication between constructing and operating elements was poor. Frequent breaks in the lines occasioned delays. But the main factor which caused the construction of the pipelines to appear to lag behind was the phenomenal speed of the advancing Allied forces after the Normandy breakout. These pipeline units laid pipe at the rate of thirty or thirty-five miles a week but still could not keep up. Gasoline, food and ammunition competed for available transportation as the pursuit gradually slowed.

Although the pipeline units failed to keep pace with Lt. Gen. George S. Patton, Jr., in his spectacular dash across France, this was no measure of their usefulness in modern warfare. These companies provided critical fuels to strategic points in every theater, sup-

porting well the striking power of the new mobile Army. During the course of the war, they laid over 3,000 miles of pipeline in each of three theaters, European, Mediterranean, and CBI, and lesser amounts in the Pacific. They performed particularly well in the rugged terrain of Italy as attested by the Chief Engineer of the Mediterranean theater who considered them among the best special engineer troops he had ever seen.[44]

[44] (1) Rad, CO Engr Dist 12 to CG Constr Sv SOS CBI, 15 Aug 44. Opns Br file, Constr Sv CBI (C). (2) Ltr, CO Engr Dist 12 to CG Constr Sv SOS CBI, 26 Aug 44, sub: Pipeline Safety and Security Program. Opns Br file, Constr Sv CBI (S). (3) Ltr, Actg ACofEngrs to C Engr USAF CBI, 3 Nov 44. Adm Br file, Constr Sv CBI. (4) Ruppenthal, *op. cit.*, I, Ch. XIII.